

Electromagnetic Engineering (EC 21006)

T U T O R I A L - X I

HERTZIAN DIPOLE

1. A short antenna with a uniform current distribution in air has $I_0 d = 3 \times 10^{-4} \text{ A} \cdot \text{m}$ and $\lambda = 10 \text{ cm}$.

Find $|E_{\theta_s}|$ at $\theta = 90^\circ$, $\phi = 0^\circ$, and $r =$: (a) 2 cm; (b) 20 cm; (c) 200 cm.

2. A short current element has $d = 0.03\lambda$. Calculate the radiation resistance for each of the following current distributions:

(a) uniform, I_0 ;

(b) linear, $I(z) = I_0(0.5d - |z|)/0.5d$;

(c) step, I_0 for $0 < |z| < 0.25d$ and $0.5I_0$ for $0.25d < |z| < 0.5d$.

3. A dipole antenna in free space has a linear current distribution. If the length d is 0.02λ , what value of I_0 is required to :

(a) provide a radiation field amplitude of 100mV/m at a distance of 1mi. at $\theta = 90^\circ$;

(b) radiate a total power of 1W.

4. A short dipole carrying current $I_0 \cos(\omega t)$ in the \mathbf{a}_z direction is located at the origin in free space.

(a) If $\beta = 1 \text{ rad/m}$, $r = 2\text{m}$, $\theta = 45^\circ$, $\phi = 0$, and $t = 0$, give a unit vector in rectangular components that shows the instantaneous direction of \mathbf{E} .

(b) what fraction of the total average power is radiated in the belt $80^\circ < \theta < 100^\circ$?